

Art Unit: 1754

1. (AMENDED) A method for reducing the tendency of paper to curl in a drying section of a paper machine, comprising

drying a paper web having opposed bottom and top sides by pressing the bottom side of the web against heated faces of a plurality of drying cylinders in the drying section of a paper machine,

after the bottom side of the web separates from the heated face of a drying cylinder, raising the temperature of the bottom side of the web by applying a sufficient amount of steam onto the bottom side of the web to control the moisture gradient in the thickness direction of the paper web between the paper web sides in a steam treatment onto the entire width of the paper web in the drying section such that tensions that have been formed [or that tend to be formed] in the fiber mesh are relaxed by means of heat and moisture from the steam in the area of their formation or thereafter,

said steam treatment being applied to an open face of the bottom side of the paper web as it runs on a wire in a suction sector of a suction roll or cylinder in said drying section and in an area of said drying section where the dry solids content of the paper web is from about 70 to 98 percent, and

promoting the penetration of said steam treatment into the paper web in a direction of the thickness of the paper web by means of suction present on said suction sector, to thereby control curling of the web.--

2. The method of claim 1, further comprising applying said steam treatment at an end of the drying section.

3. The method of claim 1, further comprising applying said steam treatment in an area of said drying section where the dry solids content of the paper web is from about 80 to about 95 percent.

4. The method of claim 1, further comprising providing said drying section with groups of drying cylinders with single-wire draw, arranging said drying cylinders in an upper row, and arranging said suction roll or cylinder in a lower row, such that paper broke can be removed directly through open intermediate spaces located underneath said drying cylinders.

5. The method of claim 1, further comprising blowing air into spaces defined between the wire and said suction roll or cylinder.

Art Unit: 1754

—6. (AMENDED) A drying section of a paper machine, comprising at least one drying section group comprising

a plurality of drying cylinders for drying a paper web having opposed bottom and top sides, said drying cylinders each having a heated surface,

a drying wire running in a meandering fashion over said drying cylinders, said drying wire pressing the bottom side of the paper web against said heated surfaces of said drying cylinders,

at least one steam box arranged in said drying group and comprising a counter-face which, together with a free face of the paper web, defines a contact-free steam-treatment gap in said drying group, said steam box extending substantially across an entire transverse width of the paper web,

said steam box being positioned in a location after the bottom side of the web has separated from one of said heated surfaces of said drying cylinders and applying steam onto the bottom side of the web to raise the temperature of the bottom side of the web and control a moisture gradient in a direction of thickness of the paper web between the paper web sides substantially across an entire width of the paper web such that tensions that have been formed [or that tend to be formed] in the fiber mesh of the paper web are relaxed by means of heat and moisture in the area of their formation or substantially immediately thereafter, and said steam box applying steam to the paper web during the run of the paper web on a wire through the drying section the tendency of the paper web to curl is prevented in the run of the paper web through the drying section.—

7. The drying section of claim 6, wherein said steam box further comprises regulating means, said regulating means controlling the quantity of steam supplied by the steam box across the transverse width of the paper web.

8. The drying section of claim 7, wherein said steam box is arranged in an area of said drying section where the dry solids content of the paper web is from about 80 to about 95 percent, by weight.

9. The drying section of claim 6, wherein said drying group further comprises a plurality of wire guide rolls and/or leading cylinders over which the paper web runs, at least one of said wire guide rolls or leading cylinders being a suction-leading cylinder provided with negative pressure, said steam box being placed in an area of said drying section having a single-wire draw on a suction zone of said suction-leading cylinder, such that the negative pressure prevailing in interior spaces of said suction-leading cylinder supports the paper web and promotes the action of the steam on the paper.

10. The drying section of claim 9 which comprises at least two drying section groups, at least one guide roll located in a gap between said drying group sections for guiding the paper web, said steam box being fitted opposite said guide roll.

Art Unit: 1754

11. The drying section of claim 9, wherein said drying section group has a single-wire draw in which steam is applied to the paper web running on the wire, said drying cylinders being arranged in an upper row and said wire guide rolls and/or leading cylinders being arranged in a lower row below said drying cylinders.

12. The drying section of claim 11, wherein said drying section groups comprise a plurality of additional steam boxes fitted in connection with additional ones of said leading cylinders and/or said wire guide rolls.

13. The drying section of claim 9, wherein said suction-leading cylinder has an interior portion and an outer perforated and grooved mantle, whereby suction in the interior of said suction-leading cylinder is spread onto a circumference of said suction-leading cylinder to thereby promote penetration of steam into the paper web.

14. The drying section of claim 9, further comprising blow boxes for blowing air into spaces defined between said drying wire and said leading cylinders.

15. The drying section of claim 9, further comprising at least one inverted drying section group in which drying cylinders are arranged in a lower row and wire guide rolls and/or leading cylinders are arranged in an upper row above said drying cylinders, said at least one inverted drying section group being arranged adjacent to said at least one drying section group.

16. The drying section of claim 15, wherein the web is transferred from a wire in said at least one drying section group to a wire in said at least one inverted drying section group as a closed draw.

17. The drying section of claim 6, wherein said steam box is arranged in an area of said drying section where the dry solids content of the paper web is from about 70 to about 98 percent, by weight.

Art Unit: 1754

-18. (AMENDED) A method for reducing the tendency of paper to curl in a drying section of a paper machine, comprising

drying a paper web having opposed top and bottom sides by pressing the bottom side of the web against heated faces of a plurality of drying cylinders in the drying section of a paper machine,

applying a sufficient amount of steam onto the bottom side of the web to control the moisture gradient in the thickness direction of the paper web between the paper web sides in a steam treatment onto the entire width of the paper web in the drying section such that tensions that have been formed [or that tend to be formed] in the fiber mesh are relaxed by means of heat and moisture from the steam in the area of their formation or thereafter,

arranging said drying cylinders in an upper row and a lower row,

arranging suction rolls or cylinders in gaps between said drying cylinders in said upper row and said lower row,

applying said steam treatment to a free draw of the paper web located between said upper row and said lower row of said drying cylinders, and

applying steam onto at least one side of the paper web, to thereby control curling of the web.--

19. The method of claim 18, further comprising applying said steam treatment in an area of said drying section where the dry solids content of the paper web is from about 70 to about 98 percent.

20. The method of claim 18, further comprising applying said steam treatment in an area of said drying section where the dry solids content of the paper web is from about 80 to about 95 percent.

21. The method of claim 18, further comprising applying said steam treatment at an end of the drying section.

22. The method of claim 18, further comprising carrying the web on a wire around said drying cylinders and said suction rolls or cylinders such that the wire runs in a meandering fashion over said drying cylinders and said suction rolls or cylinders and blowing air into spaces defined between the wire and said suction rolls or cylinders.

23. The method of claim 18, further comprising arranging a first steam box to apply steam onto a first side of the web in the free draw and arranging a second steam box to apply steam onto an opposite side of the web in the free draw.

Application/Control Number: 08/861,231

Art Unit: 1754

—24. (AMENDED) A method for reducing the tendency of paper to curl in a drying section of a paper machine, comprising:

drying a paper web having opposed top and bottom sides by pressing the bottom side of the web against heated faces of a plurality of drying cylinders in the drying section of

a paper machine,

after the bottom side of the web separates from the heated face of a drying cylinder, raising the temperature of the bottom side of the web by applying a sufficient amount of steam onto the bottom side of the web to control the moisture gradient in the thickness direction of the paper web between the paper web sides in a steam treatment onto the entire width of the paper web in the drying section such that tensions that have been formed [or that tend to be formed] in the fiber mesh are relaxed by means of heat and moisture from the steam in the area of their formation or thereafter,

said steam treatment being applied to an open face of the bottom side of the paper web as it runs on a wire in a suction sector of a suction roll or cylinder located at an end of said drying section, and

promoting the penetration of said steam treatment into the paper web in a direction of the thickness of the paper web by means of suction present on said suction sector, to thereby control curling of the web.—

—25. (AMENDED) A method for reducing the tendency of paper to curl in a drying section of a paper machine, comprising

drying a paper web having opposed top and bottom sides by pressing the bottom side of the web against heated faces of a plurality of drying cylinders in the drying section of a paper machine,

after the bottom side of the web separates from the heated face of a drying cylinder and the temperature of the bottom side decreases to a temperature below the

Art Unit: 1754

temperature of the top side of the web, raising the temperature of the bottom side of the web to a temperature above the temperature of the top side of the web by applying steam on the bottom side of the web to thereby control the moisture gradient in the thickness direction of the paper web between the paper web sides such that tensions that have been formed [or that tend to be formed] in the fiber mesh are relaxed by means of heat and moisture from the steam in the area of their formation or thereafter, and

said steam treatment being applied to an open face of the bottom side of the paper web as it runs on a wire in said drying section.--

---

-26. A method of reducing the tendency of a paper web to curl in a paper machine, comprising the steps of:

asymmetrically drying the paper web in its thickness direction extending between the top and bottom sides of the paper web to a solids content at which curl-inducing stresses are formed in the paper web by passing the paper web through a plurality of top-felted

single-tier normal dryer groups, each of said plurality of normal dryer groups including a single tier of dryer cylinders, a plurality of suction guide rolls disposed below and between said dryer cylinders, and a single wire transporting said web over the dryer cylinders and beneath the guide rolls so that only the bottom side of said web engages said dryer cylinders; and

subsequently applying sufficient heat and moisture to the asymmetrically dried paper web to relax said stresses in the fiber mesh of the paper web, to thereby control curling of the web.--

---

27. The method of claim 26, wherein the step of asymmetrically drying the paper web includes passing the paper web through a plurality of normal dryer groups, each of said plurality of normal dryer groups including a single tier of dryer cylinders, a plurality of guide rolls disposed below and between said dryer cylinders, and a single-wire draw so that only one side of said web engages said dryer cylinders.

28. (cancelled)

29. The method of claim 26, wherein said moisture is in the form of steam condensate.

Art Unit: 1754

--30. The method claim 26, wherein said heat and moisture are applied across the entire width of the paper web.--

--31. The method of claim 26, wherein said heat and moisture are applied to said web immediately downstream of the location where said stresses are formed.--

--32. The method of claim 26, wherein said stresses in the paper web are formed at a solids content of at least about 70%.--

--33. The method of claim 26, wherein said heat and moisture are applied to the side of the web not engaging said dryer cylinders.--

--34. A paper machine, comprising:  
a dryer for asymmetrically drying a paper web in its thickness direction extending between the top and bottom sides of the paper web to a solids content at which curl-inducing stresses are formed in the paper web, said dryer including a plurality of top-felted single-tier normal dryer groups, each of said plurality of normal dryer groups including a single tier of dryer cylinders, a plurality of suction guide rolls disposed below and between said dryer cylinders, and a single wire transporting said web over the dryer cylinders and beneath the guide rolls so that only the bottom side of said web engages said dryer cylinders; and  
a device for applying heat and moisture to the asymmetrically dried paper web for relaxing said stresses to thereby control curling of the web.--

35. (cancelled)

--36. The paper machine of claim 34, wherein said device for applying heat and moisture is disposed immediately downstream of said plurality of normal dryer groups.--

--37. The paper machine of claim 34, wherein said device for applying heat and moisture extends across the entire width of the paper web.--

38. (cancelled)

Art Unit: 1754

--39. The paper machine of claim 34, wherein said stresses in said fiber mesh of the paper web are formed at a solids content of at least about 70%.--

--40. The paper machine of claim 34, wherein said device for applying heat and moisture includes a steam box.--

--41. The paper machine of claim 34, wherein said heat and moisture are applied to the side of the web not engaging said dryer cylinders.--